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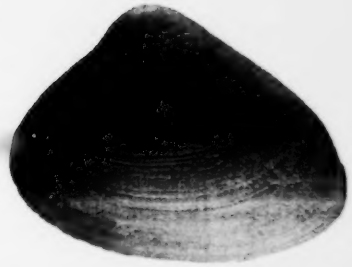
Science Advisory Report 2010/016

ASSESSMENT OF ATLANTIC SURFCLAM IN THE COASTAL WATERS OF THE ÎLES-DE-LA-MADELEINE IN 2009



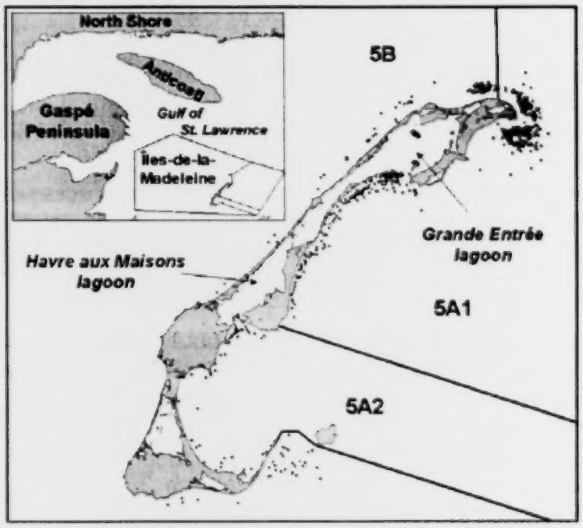


Figure 1. Management areas (5A1, 5A2 and 5B, solid line) and known distribution (red circle) of Atlantic surfclam in the Îles-de-la-Madeleine.

Context:

In Québec, the Atlantic surfclam fishery is practiced exclusively in the Îles-de-la-Madeleine. The fishery is conducted in two different ways, either by boat with a hydraulic dredge in coastal waters, or manually on foot or while diving in lagoons or near the coast. In addition, hand digging may be recreational or commercial; any harvester wishing to take more than 300 clams per day must obtain a commercial license. Dredge fishing Area 5 is divided into three sub-areas. The dredge fishery is regulated by the number of licenses, the size of the dredge, a fishing season and a minimum legal size of 76 mm. A quota of landings is also effective in sub-areas 5A1 and 5A2. This is the first stock assessment of this resource, and should henceforth be done every three years. The main indicators used for monitoring stocks are landings, fishing effort, catch per unit effort and size structure.

SUMMARY

- The Atlantic surfclam fishery in the Îles-de-la-Madeleine is conducted with hydraulic dredges in sub-areas 5A1 and 5B or using hand tools, on foot or while diving, in about ten shellfish sectors located in lagoons or near coasts. The dredge

fishery is still developing and is, in part, conducted on new portions of surfclam beds from one year to another.

Hydraulic Dredge Fishery (Sub-areas 5A1 and 5B)

- The total allowable catch (TAC), set at 113 tons (t) since 2002, has been reached virtually every year in sub-area 5A1. In 2009, landings in this sub-area totalled 116 t with a fishing effort of 44 days, which represents a 20% drop in effort compared to the average (2002 to 2008).
- Catch per unit effort (CPUE) fluctuates around the average in sub-area 5A1. In 2009, CPUE was of 163 kg per hour/meter (kg/hm), or 23% higher than average.
- Considering the stability of various commercial indicators over the last several years and having frequently reached the TAC, a 10% increase of the quota in sub-area 5A1 could be authorized for 2010.
- Prior to 2008, fishing in sub-area 5B was only occasional. However, in 2008, a bed was located north of the Îles-de-la-Madeleine, at the limit of sub-areas 5B and 5A1. This bed, 5B North, was mainly harvested in 2009.
- In 2009, landings from the 5B North bed totalled 152 t, fishing effort of 52 days and CPUE of 203 kg/hm.
- The commercial indicator values obtained on the 5B North bed were similar to those of sub-area 5A1 in 2009. However, given the small size of this bed, the harvesting pressure in 2009 was probably much higher on the 5B North bed than in sub-area 5A1.
- Given the similarity of indicators, it is recommended to implement, for the 5B North bed, conservation approaches similar to those used in sub-area 5A1, while considering the relative size of the beds.

Hand Digging

- The available information on hand digging of Atlantic surfclam, either on foot or while diving, is limited. This type of harvesting is very popular and well-developed and the harvesting effort is considerable. The average annual landings from recreational hand digging is estimated at about 131 t and exceeds the dredge yield in sub-area 5A1.
- The effort and CPUE data are very incomplete and it is difficult to assess the status of different beds harvested by hand digging. The few available logbooks show that the CPUE from commercial hand digging on foot have remained up around 23 kg/h since 2005, when calculated against all shellfish sectors. The CPUE from commercial harvesting while diving are much more inconsistent and average (2005 to 2008) 43 kg/h.
- Given the available information, it is recommended to limit the potential commercial and recreational hand digging effort to the current level.

BACKGROUND

The Atlantic surfclam, *Spisula solidissima*, is a filter feeding bivalve mollusc that lives along the Atlantic coast of North America, from Gaspé Bay in the Gulf of St. Lawrence to Cape Hatteras, in South Carolina. The surfclam habitat extends from the upper infralittoral zone to a depth of 30 to 60 m depending on the region. In the Îles-de-la-

Madeleine, the surfclam is found mainly between 0 and 20 m deep (Figure 1). The surfclam lives buried in sediments and prefers mixtures of sand, clay and gravel. It is a sedentary species living in aggregations of more or less importance called "beds".

According to the literature, age at sexual maturity of surfclams is four years. The legal catch size of 76 mm is reached in four or five years at the Îles-de-la-Madeleine. The surfclam can live more than 30 years and reach a size of 226 mm. The maximum size observed in the Îles-de-la-Madeleine is 171 mm.

The sexes are separate and there is no sexual dimorphism for the surfclam. In the Îles-de-la-Madeleine, the gonads are fully mature by mid-May. Spawning takes place mainly in July and August. The gametes are released into the water where the fertilization of ovules occurs. The larvae are pelagic. The duration of the larval phase is dependent on water temperature; 35 days at 14 °C. After metamorphosis, juveniles settle to the bottom and begin their benthic life stage.

Overall, the recommended conservation measures are to ensure the sustainability of each bed by maintaining reproductive potential. It is important to protect the diversity of a sector by ensuring the preservation of each bed within that sector.

RESOURCE ASSESSMENT

In the Îles-de-la-Madeleine, the Atlantic surfclam fishery is conducted with a hydraulic dredge in Area 5 or by using hand tools, on foot or while diving in the lagoons of Grande Entrée and Havre aux Maisons or along the coast. The minimum legal size is 76 mm for both types of harvesting. Moreover, there is a refuge area, shellfish sector A-08.4, where the Atlantic surfclam fishery is prohibited (Figure 2).

Commercial fishery indicators, or the effort and CPUE, are compiled from information taken from logbooks, while the size structures and median size is measured from the surfclams landed by the DFO's commercial catch sampling program. The dredge harvesting positions are available from the logbooks from 2002 to 2009 and from sampling at sea conducted by observers (Biorex) since 2005. CPUE have been standardized to reflect the harvesting month and fisherman.

Hydraulic Dredge Fishery

Exploratory fisheries were conducted in the Îles-de-la-Madeleine in 1976, 1984 and 1985. The area covered at that time did not reveal beds large enough to support an Atlantic surfclam commercial fishery. However, some fishermen continued to explore the territory and eventually discovered beds of interest to the commercial fishery. A management plan was only established in the fall of 2001 to oversee this commercial fishery by using mechanical gear. Monitoring this fishery became possible only in 2002, with the introduction of logbooks.

In Quebec, the commercial dredge fishery is limited to Area 5 of the Îles-de-la-Madeleine. At first, harvesting was concentrated exclusively in the east of the archipelago, in an area circumscribed by current sub-area 5A1. To encourage fishermen to explore all of Area 5, the territory was divided into two sub-areas in 2005 (5A and 5B)

and then redistributed into three sub-areas in 2008, 5A1, 5A2 and 5B (Figure 1). Despite these incentives, sub-area 5A2 has not been harvested since 2002.

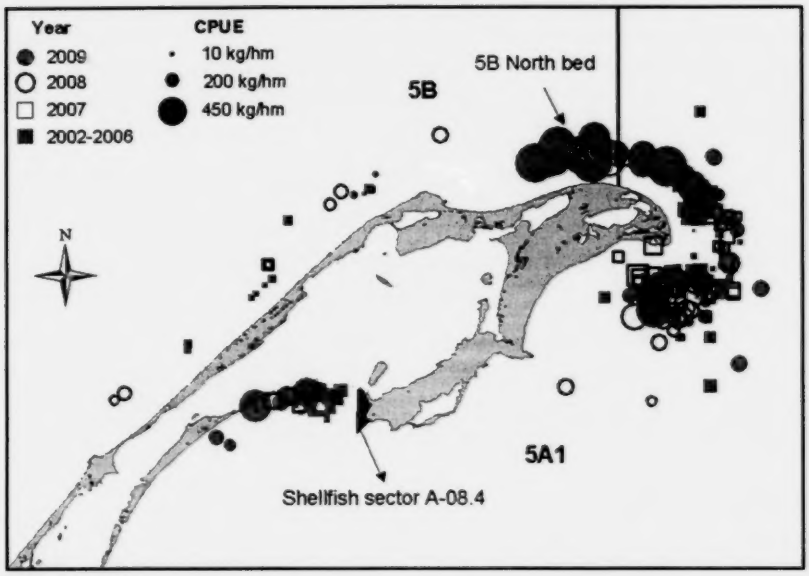


Figure 2. Catches per unit effort (kg/hm) of Atlantic surfclam and location of the 5B North bed and the refuge area (shellfish sector A-08.4).

There are four commercial dredge harvesting licenses in the Îles-de-la-Madeleine. Harvesting is permitted from early April to early July and from September 1st to mid-December in sub-areas 5A1 and 5A2. The fishery is closed in July and August during the surfclam spawning period. Harvesting in sub-area 5B is permitted from early April to mid-December, with no limitation period, to enable fishermen to explore. Since 2002, fishermen only have the right to use a single dredger with a maximum width of 2.13 m and the spacing between the rods of at least 3.175 cm. A TAC of 113 t was allocated in 2002 to Area 5 and then assigned to sub-area 5A1 in 2005. A TAC of 55 t in sub-area 5A2 has been in effect since 2005.

Sub-area 5A1

Landings of Atlantic surfclam in sub-area 5A1 have varied over the years between 105 and 121 t of live weight. The TAC of 113 t was almost reached or slightly exceeded each year. In 2009, landings totalled 116 t (Table 1).

Fishing effort in fishing days was higher (64-65 days) at the beginning of the harvesting (Table 1). Since 2005, the effort to reach the TAC has extended from 31 to 63 days. In 2009, the effort was 44 days, a 20% value below the 2002-2008 average.

CPUE have shown no trend since 2002 and the average is 132 kg/hm (Table 1). The highest value, 197 kg/hm, was obtained in 2005. In 2009, CPUE was 163 kg/hm and was significantly higher (23%) than the average (Figure 3). This fishery is still developing and is conducted, in part, on new portions of the beds from one year to another

(Figure 2). This harvesting strategy has probably helped to stabilize yields in sub-area 5A1.

Table 1 Landings (t), harvesting effort (days), catch per unit effort (CPUE in kg/hm) and median size (mm) at landing of Atlantic surfclam per harvesting sub-area and year.

Year	Sub-area 5A1				Sub-area 5B			
	Landing	Effort	CPUE	Size	Landing	Effort	CPUE	Size
2002	105	65	129.1		0			
2003	115	65	114.5		0			
2004	112	64	104.1	108	0			
2005	107	31	196.9	112	19	13	180.7	106
2006	108	54	132.7	110	2	2		
2007	121	63	109.5	125	4	3		
2008	120	42	139.2	121	39	20	78.1	119
2009	116	44	163.2	122	152	52	203.1	123
Average[1]	**112**	**55**	**132.3**	**115**				

[1] 2002-2008 average for each indicator, except for median size where years 2004-2008 were used.

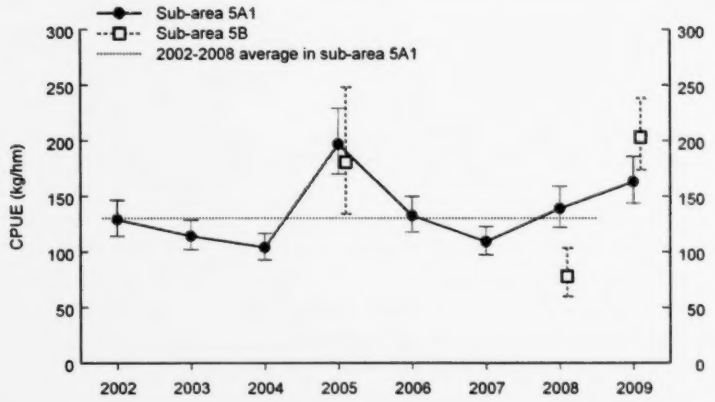


Figure 3. Catch per unit effort (kg/hm ± confidence interval of 95%) of Atlantic surfclam per harvesting sub-area and year.

The size of the harvested beds in sub-area 5A1 is estimated at 19.4 km^2 from recorded fishing positions since 2002.

The size structures of surfclams landed are shown in Figure 4. The size (anteroposterior length of the shell) of surfclams landed may extend from 73 to 164 mm depending on the year, with median sizes between 108 and 125 mm (Table 1). In 2009, the median size was 122 mm, or 6% higher than the 2004-2008 average.

Sub-area 5B

Prior to 2008, harvesting in sub-area 5B was only occasional. However, in 2008, a bed was found north of the Îles-de-la-Madeleine, at the limits between sub-areas 5B and 5A1 (Figure 2). Harvesting of the 5B North bed was mostly done in 2009.

In 2009, landings from the 5B North bed totalled 152 t with a harvesting effort of 52 days (Table 1). The CPUE was estimated at 203 kg/hm for this bed (Figures 2 and 3). The range of sizes of surfclams landed in 2009 from the 5B North bed was 93 to 154 mm with a median of 123 mm (Figure 4 and Table 1). The size of the 5B North bed is estimated at 3.5 km^2 from the 2008 and 2009 harvesting positions. The 5B North bed represents approximately 20% of the size of the 5A1 beds.

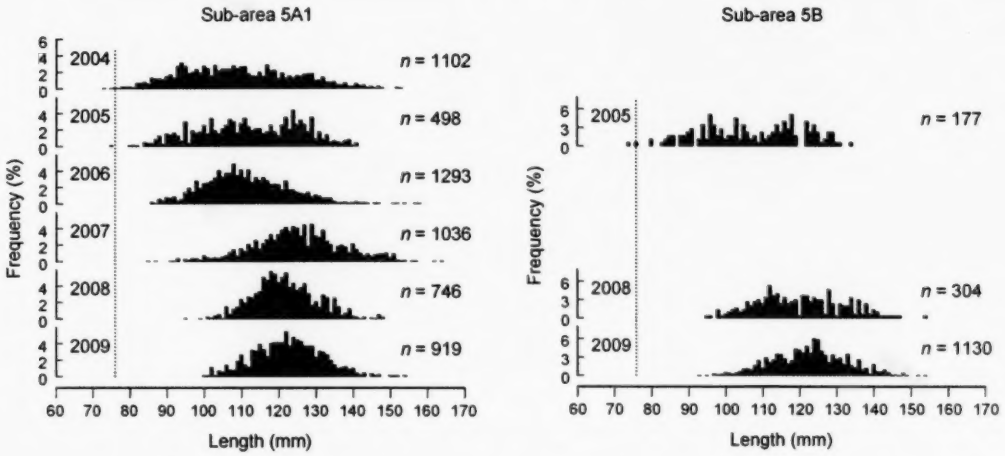


Figure 4. Size structure of Atlantic surfclam landed per harvesting sub-area and year and number (n) of measured surfclams. The vertical dotted line indicates the minimum catch size of 76 mm.

Hand Digging

In 2003, new provisions amending the 1985 Atlantic Fisheries Regulations, provided a better framework for recreational harvesting of several molluscs, including the Atlantic surfclam, by indicating the species, authorized tool, minimum catch size and daily limit. An initial management plan was established in 2005 to regulate hand digging (hand tools) of Atlantic surfclam in the Îles-de-la-Madeleine. Since then, any hand harvester wishing to harvest more than 300 clams per day or earn an income must obtain a commercial license, regardless of whether harvesting on foot or while diving. Between 122 and 135 licenses have been issued annually since 2005. Commercial or recreational manual harvests are legislated by a harvesting season of nearly 12 months, from mid-January to late December, and by a minimum legal size of 76 mm. Commercial harvesters must keep a logbook.

Manual harvesting of surfclams is an activity that has a long history in the Îles-de-la-Madeleine' lagoons or near its coast. Harvesting is very popular during the summer. It is practiced in about ten shellfish sectors but more intensively in sectors A-09.5 and A-09.1 located in the Grande Entrée lagoon, (mainly islands B and C), along Dune-du-Sud (A-12.1), at the Camping Gros-Cap (A-16.2.1.1) and along the Plage de La Martinique (A-17.1) (Figure 5). According to a census conducted annually by volunteers, on finer summer days, there may be more than 50 harvesters on the same bed.

Despite its popularity, the available information on hand harvesting, whether on foot or while diving, is limited. Less than 50% of active commercial harvesters keep logbooks and there is virtually no information from recreational hand digging.

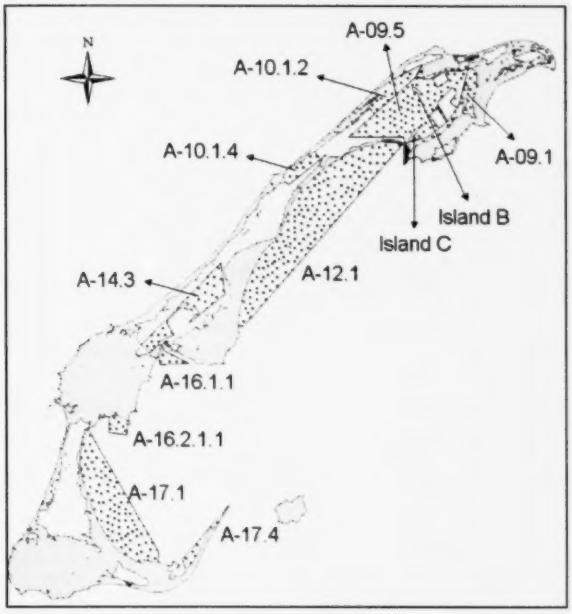


Figure 5. Location of the primary shellfish sectors harvested by hand digging of Atlantic surfclam.

Landings from commercial harvesting on foot ranged from 10.2 to 21.7 t between 2005 and 2008 and between 1.5 to 17.1 t for commercial harvesting while diving (Table 2). The available information for 2009 is preliminary. Annual landings from manual recreational harvesting are estimated from information collected from license holders (by questionnaire) and from population censuses carried out directly on the beds. The average landings from 2002 to 2008, for this type of harvesting, are estimated at about 131 t (Table 2). This value exceeds the total catch made by dredging in sub-area 5A1.

Since the effort and CPUE data are partial, it is difficult to assess accurately the status of the different beds harvested by hand digging. The indicators have therefore been calculated for all harvested shellfish sectors.

Information from logbooks show that the CPUE from the commercial harvest on foot has remained around 23 kg/h since 2005 (Table 2 and Figure 6). Fishing effort (i.e. gathered from logbooks) from 2009 was only 60 harvesting days. This harvest yielded the smallest landed surfclams with an average median size of 95 mm from 2005 to 2008 (Table 2 and Figure 7). In 2009, the median size was 99 mm.

The average (2005 to 2008) CPUE from the commercial harvest while diving is 43 kg/h (Table 2 and Figure 6). However, the information is lacking for 2009. The significant annual variability in CPUE is likely due to the limited number of logbooks. Since 2007, the size of surfclams landed has been high. The median size was equal to or greater than 130 mm (Table 2 and Figure 7).

Research surveys were conducted in June and September 2007 in islands B (an area of 0.56 km^2) and C (an area of 0.25 km^2) located in the Grande Entrée lagoon (Figure 5). At island B, the average relative density of legal size surfclams was estimated at 4.0 ± 0.8 surfclams/m^2 in June and 1.7 ± 0.4 surfclams/m^2 in September. The size of surfclams harvested varied between 9 and 123 mm. At island C, the density was estimated at 1.8 ± 0.6 surfclams/m^2 in early July and 1.9 ± 0.5 surfclams/m^2 in September. Surfclams measured between 9 and 111 mm.

Table 2. Landings (t), harvesting effort (days), catch per unit effort (CPUE in kg/h) and median size (mm) at landing of Atlantic surfclam for commercial harvesting on foot or while diving, as well as a landing estimate for recreational harvesting per year.

Year	Commercial on foot				Commercial while diving				Recreational
	Landing	Effort	CPUE	Size	Landing	Effort	CPUE	Size	Landing
2002									129
2003									136
2004				85					136
2005	11.3	92	23.8	89	3.4	17	31.4	118	125
2006	21.7	189	22.0	92	1.5	11	33.4	118	134
2007	15.0	156	20.5	98	17.1	66	44.2	130	138
2008	10.2	92	25.8	99	5.4	21	64.1	137	122
2009 [1]	6.3	60	22.6	99	0.3	1		135	
Average [2]	**14.6**	**132**	**23.0**	**95**	**6.0**	**26**	**43.3**	**126**	**131**

[1] Preliminary data.

[2] 2002-2008 average for each indicator, except for recreational harvesting landings where years 2002-2008 were used.

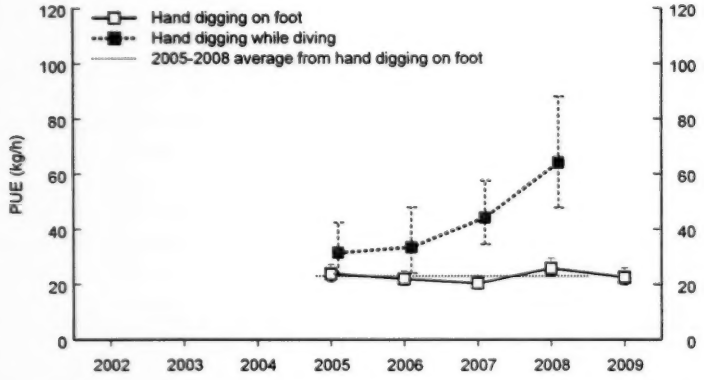


Figure 6. Catch per unit effort (kg/hm ± confidence interval of 95%) of Atlantic surfclam for the commercial harvest on foot and while diving.

Sources of Uncertainty

As the territory is shared by dredge harvesting and hand digging and between commercial and recreational harvesters, it makes it difficult to obtain a comprehensive portrait of the situation, to highlight the stock status trends and to interpret this

information. Moreover, the lack of information from hand harvesting as a whole could also affect the conclusions issued for this fishery. The lack of an independent indicator from research surveys, whether for harvested beds by dredging or by hand digging, implies that scientific advice on Atlantic surfclam stock status is entirely dependent on the quality of data from the commercial fishery.

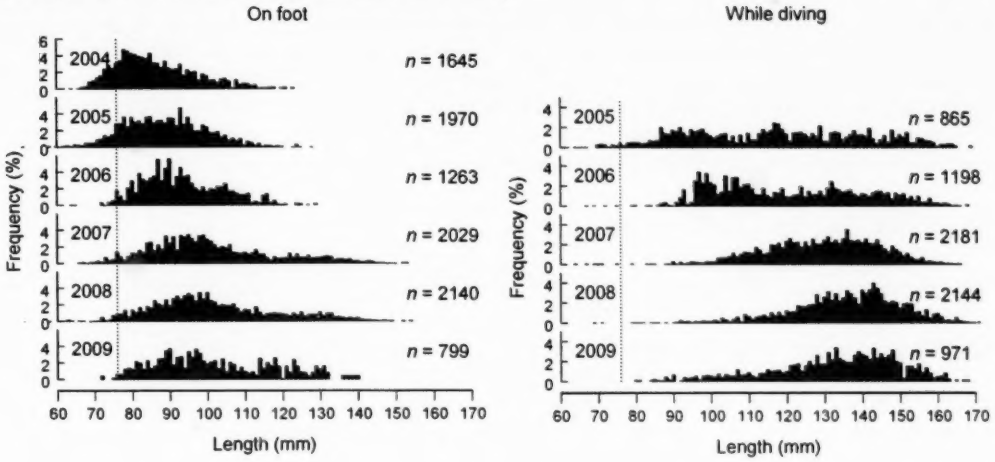


Figure 7. Size structure of Atlantic surfclam landed from the commercial harvest on foot and while diving and number (n) of measured surfclams. The vertical dotted line indicates the minimum catch size of 76 mm.

CONCLUSIONS AND ADVICE

Hydraulic Dredge Fishery (Sub-areas 5A1 and 5B)

The hydraulic dredge fishery is still developing in the Îles-de-la-Madeleine and is, in part, conducted on new portions of surfclam beds from one year to another. Under such a harvesting pattern, it is difficult to assess the status of the population from commercial indicators, so long as a full harvesting cycle has not been realized.

To adjust the quotas in sub-area 5A1, it is proposed to apply an increment-based decision rule. This rule, adopted by developing fisheries, establishes that a quota increase is considered only when the quota has been reached steadily for five years and that stock status indicators are stable or increasing. Considering the stability of various commercial fishery indicators from the Atlantic surfclam fishery in the Îles-de-la-Madeleine for several years now and that the TAC has been regularly met, a quota increase of 10% in sub-area 5A1 could be authorized for 2010.

A new bed (5B North) was located north of the Îles-de-la-Madeleine in 2008, at the limit between sub-areas 5B and 5A1. Commercial indicator values obtained on this bed were similar to those of sub-area 5A1 in 2009. However, its area was estimated at 20% of all the harvested beds in sub-area 5A1, and thus the harvesting pressure on the 5B North bed in 2009 was probably much higher than in sub-area 5A1. Given the similarity of the indicators, it is recommended to introduce, for the 5B North bed, conservation

approaches similar to those used in sub-area 5A1, while considering the relative size of the beds.

Hand Digging

Hand digging Atlantic surfclams, which has long been practiced in the Îles-de-la-Madeleine, is very popular during the summer. It is done with hand tools, on foot or while diving, in about ten shellfish sectors located in the archipelago's lagoons or near its coasts. Commercial data is only partial and it is difficult to assess the status of different shellfish beds harvested. Given the information available, it is recommended to limit the potential effort of commercial or recreational hand digging to its current level.

OTHER CONSIDERATIONS

The recommended conservation measures are designed to ensure the sustainability of each bed and to allow them to renew themselves. Any approach aimed at maintaining or even increasing the reproductive potential of each shellfish sector, by leaving more adults on the bottom or by creating refuge areas, will have a positive impact on resource conservation. The cessation of harvesting during spawning and when juveniles are deposited on the bottom can only be beneficial in protecting the reproductive potential.

Increased knowledge about the species and the harvesting history and increased monitoring of the fishery (logbooks, index-fishermen, etc) would provide a quicker reaction to population changes and guide future actions for readjusting the harvesting level and thus avoid overexploitation of the resource.

SOURCES OF INFORMATION

Gendron, L. 1988. Exploitation et état du stock de mactres (*Spisula solidissima*) des Îles-de-la-Madeleine en 1986. Rapp. manusc. can. sci. halieut. aquat. 1993 : vi +17 p.

Giguère, M., S. Brulotte, N. Paille and J. Fortin. 2005. Mise à jour des connaissances sur la biologie et l'exploitation de la mactre de l'Atlantique (*Spisula solidissima*) aux Îles-de-la-Madeleine. Rapp. tech. can. sci. halieut. aquat. 2587 : ix + 32 p.

CSSP (Canadian Shellfish Sanitation Program). 2009. Government of Canada. http://www.mollusca.gc.ca (updated 19/11/2009).

Weinberg, J. R. 1999. Age-structure, recruitment, and adult mortality in populations of the Atlantic surfclam, *Spisula solidissima*, from 1978 to 1997. Mar. Biol. 134 : 113-125.

FOR MORE INFORMATION

Contact: Sylvie Brulotte
Maurice Lamontagne Institute
850 route de la Mer
P.O. Box 1000
Mont-Joli (Québec)
G5H 3Z4

Telephone: (418) 775-0588
Fax: (418) 775-0740
E-Mail: Sylvie.Brulotte@dfo-mpo.gc.ca

This report is available from the:

Center for Science Advice (CSA)
Québec Region
Fisheries and Oceans Canada
Maurice Lamontagne Institute
P.O. Box 1000, Mont-Joli
Quebec (Canada)
G5H 3Z4

Telephone: (418) 775-0825
Fax: (418) 775-0679
E-Mail: Bras@dfo-mpo.gc.ca
Internet Address: www.dfo-mpo.gc.ca/csas

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